FIVE YEARS' EXPLORATIONS IN THE FOSSIL BEDS OF ALBERTA.

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IN the early part of the year 1912, with my son George F., I went to the Victoria Memorial Museum at Ottawa, Canada, with a skeleton of a Kansas mosasaur, *Platecarpus coryphæus;* a large fossil fish, *Porthus molossus;* and a skeleton of a *Titanotherium,* which I discovered in the Oligocene of Niobrara county, Wyoming. The other two skeletons George found in the Kansas chalk. We mounted this material, working from March until sometime in June. We found there a great museum building with little original material for exhibition, chiefly casts, and a few common fossil reptiles from Europe. Doctor Brock, the director of the museum, was anxious to secure the services of myself and my sons to build up for their museum a collection of the wonderful horned, crested duck-bills, and plated dinosaurs of the rich fossil beds of the Red Deer river. The Survey had discovered these beds twenty-five years before.

Barnum Brown, the great fossil reptilian collector and student, was already reaping a rich harvest in this field for the American Museum of Natural History of New York. Although collectors had spent three seasons in this field early in our century, no complete skeletons for mounting were added to their store until the fall of 1912, when my son, Charles M., found a thirty-two foot duck-billed dinosaur of the genus *Trachodon.* The skeleton was complete except the tail. We mounted it as a slab mount in the Victoria Memorial Museum. Mr. L. M. Lambe, the vertebrate paleontologist of the Geological Survey, in a popular description of it in the *Standard,* Montreal, Canada, August 23, 1913, says in his title to the illustration: "Canada's first complete dinosaur. This magnificent specimen, which is now in the museum of the Geological Survey, in Ottawa, is the one discovered last year in the bad lands of Alberta. The animal is supposed to have lived over 3,000,000 years ago. It is the first complete skeleton of its kind in Canada." We also found another genus of the trachodonts not yet described. This material was from the Edmonton series of the Cretaceous, supposed to approach closely the Lance beds of Wyoming.

We entered the field at Drumheller, Alberta, the center now of a rich coal field with extensive mines. The chasm of the Red Deer river is about two miles wide, nearly five hundred feet deep, with exposed strata on each side of the river. Here is a brackish-water deposit of clays and fine sand, with coal beds of enormous areal extent—simply inexhaustible. The farmers are allowed to mine all the coal they need for their own use, on the payment of a small royalty.

The next season I moved down the river eighty miles from Drumheller to the fresh-water deposit of the Belly river series, which is of the same age as the Pierre, which lies immediately above, showing that in this region the land had been elevated above the Pierre ocean. We found Pierre plesiosaurs in the Belly river beds, showing that the rivers and bayous emptied into the sea near by. The plesiosaurs swam inland and often left their bones to mingle with the land and swamp dinosaurs.

Doctor Brock, the director of the Geological Survey, and deputy minister, who employed me, says in his report for 1912.[1]

"Perhaps the most notable additions to the collections, at all events the most striking, have been the dinosaurs collected the past season by Mr. Charles H. Sternberg, perhaps the best-known collector in the world, whose specimens are to be found in all the great museums. The services of Mr. Sternberg and his son Charles have been secured, and he was sent on a well-equipped expedition to collect vertebrate remains from the rich bone beds discovered by the Geological Survey twenty-five years ago in the Red Deer river, Alberta. This expedition was fortunate enough to discover two complete specimens of the large duck-billed dinosaurs. A well-equipped vertebrate paleontological laboratory has been installed, and in it one of the specimens, thirty-two feet long, is being mounted by Mr. Sternberg and his son, as a panel mount."

In his report for 1913[2] Doctor Brock says:

"The most notable additions have, however, been made in vertebrate paleontology. Mr. C. H. Sternberg, assisted by his sons, has succeeded in recovering from the Edmonton and Belly river beds of the Red Deer river a priceless collection of the monsters that formerly inhabited this region. The material is rich, not only in new species, but in new genera, and many of the specimens are, therefore, type specimens. Several striking mounts of these animals have been prepared and are on exhibition, and good progress has been made on others, which will prove of exceptional interest and value."

Among the wonderful dinosaurs of the Belly river formation, I believe the most unique is Lambe's *Styracosaurus albertensis.*

1. Summary Report of the Survey, 1912, p. 8.
2. Ib. 1913, p. 11.

I was so fortunate as to discover it in a deep gorge in the bad lands below Happy Jack ferry, twelve miles below Steveville. Only the skull was present. It is over six feet long. A huge horn core crowned the top of the nose, which must have been three feet long in life. Projecting behind were six horn cores, radiating from the back margin, the longest ones being twenty-six inches long. I believe the entire top of the head, crest and horn cores were sheathed in horn. I also believe that this head was used in life as a shield to protect the vital organs. The skin was covered with small scales arranged like mosaic work in a payment. When he was attacked by a carnivorous enemy he stood at bay and presented this impenetrable armor of defense.

The most valuable specimen found in 1913 was the nearly complete skeleton of a great carnivorous dinosaur. Mr. Lambe has named it *Gorgosaurus libratus*. This specimen, the most complete of any Cretaceous carnivore known, was found by my second son, Charles M. The skeleton is nearly complete, with the skull and lower jaws, with all the teeth present. The most remarkable thing about it is that the front limb and the ventral ribs are with it and in position, for the first time in a single individual. Twenty-eight feet of the skeleton was found. The hind limbs are ten and a half feet long; the feet themselves over three feet long, armed with great claws, which were once covered with horn. Terrible weapons, indeed! The jaws are three feet long and armed with long, serrate-edged teeth, many of which are six inches in length. The front limbs were vestiges, twenty-three inches in length, with no apparent use. The ventral ribs sheathed the abdominal walls as if hooped in steel.

Among the duck-bills was the wonderful hooded species, with footed ischia. The head resembles that of a cassowary, the remarkable crest extending high above the top of the head, so the height was equal to the length. The footed ischia allowed the reptile to rest on them when he squatted down on the hind limbs. They indeed acted as a third leg, and not the tail as the early paleontologists thought. I have proved him to be a swimmer, in the "dinosaur mummy" my son George found in Wyoming, in 1908. I also believe his natural pose was that of a lizard. Mr. Barnum Brown, of the American Museum of Natural History, made the discovery of a still more perfect

skeleton of a crested dinosaur, which he names *Corythosaurus casuarius*. In this skeleton not only is the skin impression preserved, but the impression of the muscles and the animal's pose, as if in the act of swimming. It has a beautiful head on a long, swan-like neck, a huge body, and a long, eel-like tail. Deckert, in an ideal picture, has simply put one in his native element with the exact pose in which he died. I claim, however, that he overreaches the evidence when he stands two other forms on their hind limbs and tail, in the same picture. I will not go so far as to say that it is impossible for the creature to rise on his hind limbs; however, I do claim that it is an unusual position. I hope some day to see preparators put these creatures down on mother earth, or in the water, where they belong. When the creator shows us such wonderful specimens which absolutely contradict the preconceived opinions of men, whom should we follow?

Among the horned dinosaurs, George F. Sternberg and myself each found a skeleton of a very beautiful form, much smaller than the *Triceratops* of a later day. Mr. Lambe gives the new generic name of *Chasamosaurus*, due to the great openings in the crest. Mr. Brown, however, retains the name *Ceratops*, which Marsh gave to his Judith river species on which the family *Ceratopsia* is founded. In George's specimen we have the most perfect one of a horned dinosaur with which I am familiar. It is over five feet long, with great openings in the crest, the central bar thick in the center and beveled to a thin margin, the cross bone behind at right angles to it. I now know this bone is distinct from the skull, although it has always been called parietal. It is deeply notched in the median line. Powerful jaws hold magazines containing over two thousand teeth in three parallel rows, their grinding surfaces beveled above and below a pair of scissors, with which to shred their food after it is nipped off by the broad duck bill in front. The skin impression, too, is distinct from what has been claimed. There are pictures extant covering the thick, rhinoceroslike skin with heavy dermal scutes, a necessary protection imagined by men who neither knew the habit or the environment of the animal they recreated from a few scattered bones. In my specimen I secured many examples of the skin impression, proving it to be thin, clad in small scales, arranged like mosaic

work in a payment, five-to-seven-sided figures, or rounded in shape, often two inches in diameter, with many closely crowded, small six-sided scales, down to mere tubercles, as a background for the ornamental ones. They are not imbricated or overlapped; each scale is distinct, almost touching the edges of the ones opposite. The head was the largest part of the creature, and the crest behind nearly covered the small body. One skull is mounted at Ottawa and the other rapidly approaching completion.

Charlie and I secured two fine skulls of another strange form, which Mr. Lambe calls *Centrosaurus,* but Brown retains the name Cope gave the form he found in Montana in 1878, namely *Monoclonius.* By the way, I went with two other members of the Geological Survey to the Judith river of Montana in 1914, and went over the field I had explored with Professor Cope in 1876, and from incontestible evidence was forced to the conclusion that the Judith river beds of Montana are identical with those of the Belly river series of the Red Deer river of Alberta. These huge skulls had small round openings, across which lay bundles of ossified tendons, resembling horns. These were likely bony tendons, strong and elastic, used to move the lower jaws. A pair of recurved horn cores in the central line of the crest behind are also characteristic of this great dinosaur, nearly as large as *Triceratops.* We have mounted two fine skulls in Ottawa. Charlie's specimen, though somewhat crushed, reveals distinctly every bone that goes to make up the head.

Charlie also found the magnificent skull of the trichodont, which George Sternberg mounted for the Survey. Mr. Lambe considers this new, and calls it *Grypsosaurus.* It closely resembles Brown's *Kritosaurus,* from New Mexico. This skull is the most perfect of any of the trachodont family. It is of huge proportions, with high quadrates and exceedingly high nasals. These help to form a large Roman nose. Still another species of the trachodonts was discovered, and is evidently new. Levi prepared it last winter, and I expected to see it described. It was described, however, by Mr. Brown from a much poorer specimen. He calls it *Prosaurolophus,* a name indicating it to be an ancestor of the *Saurolophus,* which he described from the Edmonton beds. Last summer I found

a still better specimen of the same species—complete, in fact, which was sent to the British Museum. With it were the front and hind limbs sufficiently complete to enable Dr. A. Smith Woodward to get the correct proportions—a vital thing in connection with the skull, for the identification of scattered material.

The specimen most unique and desired is a complete skeleton of the great plated dinosaur *Stegosauria,* with its wonderful arrangement of bony plates in place. George discovered a nearly complete skeleton with the skull, which Lambe calls *Stereocephalus tutus.* In this species there is a clublike protuberance at the end of the tail. I secured one with a few feet of the end of the tail. There are three great bony sections, spherical in form, flattened above and below, seventeen inches long, thirteen inches wide, and ten inches high. The distal caudal vertebræ are welded to gether by the ossification of the tendons, which lie along the spines and chevrons, into a round solid handle, as it were, which is inserted into the center of the dermal plates and united to them. What a powerful weapon with which to break the ribs of a carnivore if he got near enough, though he really needed no defense, as he could safely trust his armor, which evidently covered the entire body and is anchylosed to the top of the head. Its arrangement, to my knowledge, is not yet well known. Brown, in his restored *Ankylosaurus,* once attempted to arrange the dermal plates, but unsuccessfully, as must always be the case unless it is first seen in the specimen itself.

A wonderful discovery of Brown's is that the great plates of bones which cover the entire body have small nodules of bone arranged beneath the body, like the chain armor of the old Roman soldiers, allowing motion of the skin in any direction. This is very different from the turtle and the *Glyptodon,* which are encased in an immovable armor for life. Mr. Lambe's studies have shown that these animals wear around the neck, next to the skull, a necklace of bony plates with keeled centers. I was so fortunate two seasons ago as to find a number of the plates in position over the dorsal spines. We found pelvic arches six feet in width and ribs five feet long, showing the enormous proportions of this form. I know Mr. Brown has a large amount of stegosaurian material, and I hope soon to see it published. The skull, as is common in the family, is quite

small, the jaws sheathed in horn. The small teeth behind show little sign of much use. It would not surprise me to find species with none in functional use.

I would like to tell of other wonders of the Belly river series and the results of our four years' labor there, but time and space forbid. I have calculated that it will take twenty years of careful labor by four competent preparators to get all the material in shape for study and exhibition. Last season Levi and I were in the employ of the British Museum, collecting in the Belly river series, below Steveville, Alberta. We secured three skeletons of Brown's *Corythosaurus,* which can be mounted, two we hope as slab mounts in their own matrix, and one as an open mount. We secured forty-five large boxes full of the material. Besides the dinosaurs, we found a new turtle and a fine shell of one already known.

LAWRENCE.